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OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

The Foundry Trades' Equipment and Supplies Association

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The Third Metal Age

Quite a few ironfounders have questioned our policy in accepting advertisements from the aluminium interests, which show in no uncertain fashion that the latter have every intention, as soon as peace is declared, to popularise light alloys by every means in their power. It only has to be pointed out that both the Institute of British Foundrymen and THE FOUNDRY TRADE JOURNAL cater for the needs of the whole of the foundry industry, and naturally this includes the light alloys. Our duty is to see that in the efforts to be made by the aluminium interests as many components as possible are made by foundry processes. In this objective, we are certain that we shall have the support of all well-balanced foundry opinion. We have recently had the opportunity of discussing this campaign with some of the leaders of thought in the light alloy world, and it is apparent that they have good grounds for believing that they can attract to their industry vast quantities of orders previously executed by ironfounders, manufacturers of plastics and vitreous enamellers. They base their optimism on the great strides, both metallurgical and mechanical, they have made in processing aluminium since the institution of rearmament, associated with a glut of raw materials at a price relatively much lower than ever previously. Moreover, in many markets, the anodising or colouring of aluminium ware will make an irresistible appeal, especially to the housewife. With none of these affirmations can any logical-minded individuals quarrel, and what is now to be said will divide itself up into two discussions. First, we will advise the ironfounder and the vitreous enameller as to the steps they should take to probe the depths of the competition as and when it arises. Then we will advise the aluminium manufacturers of their potential troubles. A logical method of ascertaining the seriousness of the competition is to instal a type of laboratory new to the foundry industry, but one which exists in both electrical and domestic engineering factories. The directors of such establishments rig-up an apparatus, which yields data as to the actual number of empirically standardised motions necessary to fracture the flex of an electric iron, or the number of working hours required to render inefficient the rubber driving belt, or the bristles of the brush of vacuum cleaners. Much ingenuity is shown in the devising of such tests, and the interpretation of the results is done in collaboration with the sales manager. Thus the laboratory we have in mind, consisting of unfurnished rooms, carrying normal public service supplies, would have to devise means for testing the durability and efficiency of fuse boxes made from plastics or aluminium alloys, cookers and fires made from materials other than cast iron. Expert opinion is available from the Colour Council as to the appeal of any finish to the users in various overseas markets. Brilliant, rather than subdued, colours are favoured by those nations which only recently acquired a veneer of culture. The director of such a laboratory reports to a committee of manufacturers, reinforced by trade union representatives, for they, too, are interested in the course the ship is to be steered. Obviously much other work of interest to the manufacturing and sales side of the industry could be studied by such an organisation. No work of a fundamental character would be carried out—that is the sphere of the British Cast Iron Research Association.

To those persons engaged on the expansion of the aluminium castings industry we would make the following suggestions. Acquire a complete knowledge of any prejudices which exist against the use of their product, and the reasons for the favouring of competitive materials. In our household there are, we find, prejudices against aluminium cooking utensils for strongly acid fruits, and though soda is excluded from the cooking of vegetables, its inclusion would call for some pan other than one made from a light alloy. A popular women's journal, in its current issue, warns its readers against using aluminium ware for cooking hips and haws. Again, in hotel kitchens, copper cooking equipment is preferred for many kinds of dishes, especially where the final touches are given in the actual restaurant. Our last piece of advice is a word of warning and relates to "back street" competition and price-cutting. Working under railway arches, a competent die maker can turn out remarkably cheaply incredibly large quantities of small simple castings. There are, and fortunately there always will be, ambitious operatives who will leave the larger works, and with their meagre finance embark on business on their own account. To minimise the danger of having to fight uneconomic price levels, such enterprises should never be ignored, but the new "boss" should be regarded as a "boss" and be welcomed into employers' organisations, where he will be taught the very subject of which he is usually ignorant—that of proper costing.

Some Jobbing Foundry Experiences—XXVIII

By "TRAMP"

Although in jobbing work the use of cores is avoided as much as possible, occasionally they are an advantage, especially if the job is one that is required periodically. Such a case is shown in Fig. 1, which is a portion of a grinding machine, and spares are often called for from the nearest jobbing foundry. One way of making the job would be to make a pattern as the required casting with tail prints at A, B, C to carry the holes through the wall of metal Z. This method necessitates taper on face Y which is not ideal for this particular job. Consequently a better casting is produced if the whole of the back were carried in a core suiting in the print shown by the dotted line D, D, D, D. This would allow of the face Y being made true, and the insertion of cores A, B and C in the main core before assembly in the mould, and so dispense with the building-over necessary when using tail print as in the former method. To withstand abrasion these castings are required

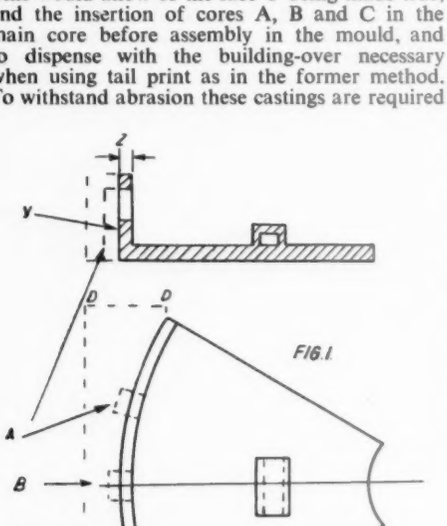

FIG. 1

hard, and for this class work all the hard scrap available is used. Sometimes, however, the demand for hard castings exceeds the supply of hard scrap obtainable, and the hardness must be imparted by other means. Small quantities of manganese steel scrap are a good material for increasing hardness if they can be procured, but the supplies of these are rather limited and sometimes run short. The addition of aluminium to a ladle of molten iron hardens the resultant castings, but one grave disadvantage attendant on this method is that the iron has the tendency of freezing much quicker than ordinary iron, thus leaving large "skulls" in the ladle. A method whereby the property imparted by the aluminium can be obtained while avoiding the disadvantage of the "skulls" is to place a piece of aluminium in each of the runners of the castings required hard. The metal is melted from the available materials and poured in the ordinary way. This molten iron impinging on the lump of aluminium melts it and causes it to be mixed with the incoming stream, which is thus inoculated and consequently hardens the resultant castings.

Contract Open

Manchester, October 6—Iron castings, for the Cleansing Committee. Mr. Bertram B. Jones, director of public cleansing, Town Hall, Manchester, 2.

Institute of British Foundrymen

Lantern Slide Library

A Library of lantern slides illustrating foundry plant, processes, and standard metallurgical subjects, such as typical microstructures, equilibrium diagrams, etc., is now being compiled by the Institute of British Foundrymen. Already over 250 slides have been donated by members of the Institute, and by companies associated with the industry; others are in course of preparation. In other cases individuals and firms not able to donate their slides permanently have kindly promised to loan them on request. A catalogue of all these slides is being prepared. The facilities of the library will be made available to members of the Institute.

The Institute extends to all its members and others engaged in, and associated with, the industry, an invitation to co-operate in this work, either by presenting their slides to the Library, or by sending to the Institute a detailed schedule of the slides which they are prepared to loan, on request. Those willing to co-operate are particularly asked to send with each slide a caption giving details of the illustration, so that an accurate catalogue of the whole Library may be compiled.

Many slides which lecturers have prepared have only a limited application, and whilst these may sometimes be useful outside the context of the lecture for which they were prepared, the Institute is more anxious to include in this Library subjects of general interest.

Further information may be obtained from the Assistant Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3, to whom all offers with regard to the donation or loan of slides should be addressed.

Notes from the Branches

Lancashire Branch.—The first Branch meeting of the 1941-42 Session will be held in the Engineers' Club, Albert Square, Manchester, on Saturday, October 4, at 3.30 p.m., when Mr. R. N. Rees, of the Staveley Coal & Iron Company, Limited, will present a Paper entitled: "Mechanisation Applied to Cast-Iron Pipe Manufacture," dealing principally with American and Continental practice, metal spun process, heat treatment, sand spun process, sand control, and metallurgical features, etc.

Continuation of the Business Insurance Scheme: War Damage Act

The first insurance period under the Business Scheme of the War Damage Act, 1941 (which applies to movable plant and machinery, office and shop equipment, etc., etc., goods held or used for the purpose of the business, etc.), covered the period September 3, 1939, to September 30, 1941, the premium for the full period being at the rate of 30s. per cent. payable in three instalments at 10s. per cent. An Order has now been made, that for the period October 1, 1941, to September 30, 1942, the premium shall not exceed 30s. per cent., the premium for the six months to March 31, 1942, being 15s. per cent., which will be payable at the option of the insured, either in one sum or in two instalments of 7s. 6d. (covering three months to December 31, 1941; three months to March 31, 1942). Particulars of payment for the period after March 31, 1942, will be issued in March next, but will not exceed 30s. per cent. for the year.

Random Shots

Whilst Mr. Churchill and Mr. Roosevelt are expending much thought on the planning of a peace which will make future war impossible and the lot of mankind safer and happier, there is civil war brewing at home. The manufacturers who use aluminium as their medium have been busy making an "Atlantic Charter" of their own, in which aluminium is to take the place of iron in all domestic spheres. The Bronze Age has long since past, they declare innocently enough; but they follow it up with the bombshell that so, too, has the Iron Age! That latter clause is nothing more or less than a plain ultimatum flung to the ironfounders, a few of whom are already getting headaches over how they are to answer the challenge. And yet there is hope for the ironfounders still, for at last week's Conference on "Science and World Order," Dr. C. H. Desch estimates that supplies of iron (and its twin brother, coal) may well last for thousands of years, even though copper, tin, gold and phosphates are marked down to less than a century of future life. So long as a material is provided by Nature one can reasonably suppose that man will find a use for it!

* * *

On the other hand, for purely domestic uses aluminium has its appeal, and a natty mobile kitchen unit, which is just one of Aluminium's "Nine Points" for post-war planning, certainly has its attraction. There will no longer be any need to struggle in the kitchen trying to cope with the Sunday dinner when the Missus is in bed with the doctor (pardon the phrase) in attendance. It will only be necessary to wheel the mobile cooker into her room and order her to get on with the job. At the worst one can work oneself under her supervision. Not a bad notion in these maidless establishments!

* * *

The Stuff that can't be Kilt!

One effect of the clothes rationing scheme is the re-appearance of the kilt in Scotland. One "plaid" which has been brought into use again after many long years in the family chest is reputed to be at least a hundred years old and still as good as new.

* * *

The Princess of Ruritania, on arrival by plane in the States, was surrounded by a crowd of journalists anxious to secure a "scoop." "And we to understand," suggested one particularly insistent reporter, "that you are expecting a happy event and will therefore stay in the States for some considerable time?"

"You can tell your public," answered the Princess, sweetly, "that no such happy event can be contemplated."

That evening one of these reporters excelled himself in his paper with the following headline: "Princess air-minded but not heir-conditioned."

* * *

Many a nasty accident has been caused, says Mrs. Malaprop, by absent-minded people germinating over their troubles as they cross the street.

* * *

The best crossword clue of the week comes from the "Sunday Times." Clue: Flying receptacle for poison. Answer: Bluebottle.

"MARKSMAN."

Effect of Sulphur and Ash in Blast-Furnace Coke

According to I. S. KAGAN and I. M. DIK "Teori. prakt. met.," investigations of the influence of the sulphur and ash of furnace coke on the throughput of blast furnaces show that an increase of 0.1 per cent. in coke sulphur raises the coke consumption per metric ton of pig-iron by 24 kg. The same increase in coke consumption is obtained for every 1 per cent increase in ash content.

Institute of British Foundrymen

(SOUTH AFRICAN BRANCH)

ANNUAL DINNER AND GENERAL MEETING

Nearly sixty members were present at the annual dinner and general meeting of the Institute of British Foundrymen (South African Branch), which took place at the Victoria Hotel, Johannesburg, on June 26, 1941. The function was one of those informal affairs which are so pleasantly characteristic of the Institute, and the evening was thoroughly enjoyed by all who were able to attend.

Mr. Petersen, the retiring President, extended a warm welcome to Mr. H. G. Issels, a member from Rhodesia, who was present at the meeting. He also stated that a letter had been received from a Durban member, Mr. S. H. Wright, wishing the function every success. After the loyal toast had been duly given, Mr. Petersen opened the business of the meeting by giving his valedictory address.

Valedictory Address

In the course of his valedictory address, Mr. Petersen said:—"The South African Branch of the Institute of British Foundrymen was founded in March, 1937, or just over four years ago. We can, one and all, be proud of the progress the Branch has made during its brief existence. The retiring members of your Council will, no doubt, recollect the headaches we acquired at our first Council meeting of the year we complete to-night. We had no Papers in hand, and attendances at meetings were not too wonderful. At that particular meeting, the headaches of the newly-elected President were probably the worst, but Mr. Ward and Mr. Holdsworth came to my rescue by promising to promote, or provoke, discussions on a couple of selected subjects. These items were duly put on the agenda. Members turned up in force, and a most interesting and instructive meeting was the result.

"I would like here to comment on the excellent attendances at all our meetings. The percentage of members attending has been considerably higher than that of any other technical society in this country, and the actual attendances have numerically been as good as, or even better than, those of other technical bodies having a total membership four or five times as great as ours.

Publication of Papers

"The 'Engineer and Foundryman' has, since our inception, been our official organ and printed our Papers, sending a copy to all members monthly.

"During the year your Council, inspired by the annual volume published by the parent body, tried a new venture, namely, the publication of a volume of Papers read before this Branch. The financing of the experiment was above our means, but several public-spirited subscribing firms and private members came to our rescue with donations and the volume became an accomplished fact. I have reason to believe that our effort was well received by members and your Council hopes to be able to continue the publication of annual volumes of Proceedings.

"Our Branch can be proud of the fact that many of the Papers read before it have been reproduced in THE FOUNDRY TRADE JOURNAL.

"During the past year, the question of joining the Associated Scientific and Technical Societies at Kelvin House was fully investigated by your Council, but after due and full consideration of the matter, your Council felt that to join that body would be inopportune just at present. It felt that, if we joined up, and moved into the main hall, our meetings might lose much of their informal and cosy atmosphere, which atmosphere, I am sure, has much to do with the success of our meetings.

Diplomas

"At this stage I have pleasure in announcing that your Council has decided to present a diploma to Mr. J. H. West for his Paper entitled 'An Interesting Job.' The originality of the Paper, and its excellent presentation influenced the Council in its decision, owing to the general high standard of the Papers presented. As you are all aware, many excellent jobs of work have been done in foundries during the past year, and your Council has decided to award a Diploma in recognition of the most outstanding piece of foundry work brought to its notice. Members are requested to send in nominations for this honour within three weeks from to-night. This Diploma may be awarded either to an individual or a firm. It will take the form of a plaque, and will certainly not be lightly awarded.

The War Effort

"If you look back, I think you will agree with me that the foundrymen in this country can be proud of their achievements since this war began. Many of us have tackled, and successfully completed, jobs which a couple of years ago we would have declined with thanks. The efforts of our members in such matters as the production of bombs of all sizes, machine tools, special munitions machinery and the like cannot be too highly commended.

"May I here be permitted to refer to our war effort: Owing to the nature of this war, many of our previous ideas had to go by the board. To win this war we must co-operate in every possible way. We cannot waste time in industrial arguments. We must get on with the job. Many of our members are doubtlessly dissatisfied because they cannot join the Forces, but we must all face the fact that our job is here, whether it be on the floor or in some superior capacity—whether it be on munitions, or on the maintenance of essential activities. We must be careful that our spirit for service is neither defeated nor dissipated. Our defence requirements are increasing, and so is the demand for men of ability and ingenuity. The general standard of the Papers and discussions in this Institute has proved that its members possess these qualities, and it is up to all of us to make the fullest use of them, by training and assisting those who have, by force of circumstances, been called in to assist us in this hour of need.

Valuable Discussions

"We have had many interesting discussions on foundry problems of all kinds, and the progress that our industry has made of recent years has come to light in the course of these discussions. A few years ago machines in the foundry were few and far between, but to-day only the very small foundry is without them. One firm is even equipping what is practically a completely mechanised foundry for the production of light castings. Core-blowing seems to be finding its rightful place, in spite of many teething troubles, some of which were apparently due to that mysterious word 'venting.'

"These discussions have proved the value of, and the necessity for, a body such as ours. All other branches of engineering have had their technical societies in this country for many years. There is no doubt that the rapid strides the mining industry has made have been largely due to the technical discussions which have taken place at such meetings. The results of experiments and departures from current practice have been made known, discussed and criticised, and the results co-ordinated to the benefit of the industry.

"We, as foundrymen, are now heading in the right direction. We have our Institute where we discuss our problems, accept criticism or suggestions with gratitude, and benefit as the result. As long as we go forward on these lines, our Institute must be a success, and, what is more, a national asset.

The Post-War Period

"Let us look forward to the period after the war. Whether we will have the industrial boom we all hope for, or not, one thing is certain: we must have a period of intensive industrial development. To-day, owing to the war, we are not only attempting to supply the industrial requirements of the Union, but also those of adjacent territories as far north as the Congo. I believe I am safe in saying that we are succeeding in that attempt. We must be candid and admit that for many years we were far behind other countries in foundry practice. During the last few years we have made up much leeway, and I do not think that I can be accused of boasting if I say that much of that progress has been due to this Institute, which can justly claim credit for the dissemination of much useful information regarding methods and plant through its meetings. This fact has apparently been appreciated by our colleagues, and is reflected in the number of our members, for, after all, is not the criterion of the value of an Institute its increasing membership?

"In conclusion, I wish to thank my colleagues on the Council for the help they have given me during my year of office. I particularly wish to thank Mr. Robertson, who has since retired from the Council, for the excellent work he did in connection with the volume of Papers. Last, but not least, I wish to thank our Hon. Secretary and his staff for the excellent work they have done during the past year."

A Successful Session

MR. NIMMO DEWAR said it gave him great pleasure to move the adoption of the report so ably set out by the retiring President. Mr. Petersen had given members an excellent résumé of the work done during the past year. With the usual modesty of presidents, he had indicated the valuable help received from members, while completely ignoring the inspiration given by himself. Mr. Petersen had been a tower of strength and had been associated with a particularly happy and successful year. Yet it had been a year of genuine difficulty, in which the position of South Africa had been almost entirely in the melting pot. The Institute had played a very definite part in assisting towards the attainment of what it was hoped would be final victory.

"Here in the city of Johannesburg," said Mr. Nimmo Dewar, "the Institute of British Foundrymen (South African Branch) is labouring day and night to produce weapons to deal with the Powers of Darkness." He considered that Mr. Petersen and his successor were privileged to hold office in times so stirring and so real. The Branch was performing useful work against Hitler.

Election of Officers

MR. PETERSEN thanked Mr. Nimmo Dewar for his kind words. He proposed that Mr. J. Tonge be elected President for the coming year. The motion was seconded by MR. WARD, and carried unanimously.

South African Branch

DR. MARAIS proposed Mr. D. Lion-Cachet as Vice-President. MR. STONES seconded, and this resolution was also unanimously passed.

The meeting then proceeded to the election of members to fill the three vacancies in the Council. Since Mr. Petersen automatically became a member of the Council, there were actually two vacancies to fill. The members elected were Mr. Davidson, who was proposed by Mr. Cartwright and seconded by Col. Guy; and Mr. Stones, proposed by Mr. Ward and seconded by Dr. van Eck. The new Council thus consists of the following members: Dr. H. J. van Eck, Mr. H. Holdsworth, Mr. W. J. Petersen, Mr. Davidson, and Mr. J. M. Stones.

MR. TONGE thanked the meeting for the great honour which had been conferred on him, and referred to the illustrious footsteps in which he followed. He was encouraged by the assurance of the Past-Presidents that they would at all times stand behind him, and appealed for the support of all members on the floor, without whose support no President could succeed. He asked members to give him the same opportunity for upholding the prestige of the Institute as his predecessors had enjoyed. He was very pleased to see all the Past-Presidents at the dinner, as well as two members of the original Council—Mr. Davidson and Mr. Bragg. Mr. Tonge complimented Mr. Petersen on his address. He hoped that at the end of his own term of office he could also say that he had no regrets.

South Africa's Contribution to Abyssinian Victory

DR. VAN ECK said Mr. Tonge had already commented on the fact that all Past-Presidents were present. He thought it was a great compliment to Mr. Petersen that all members of the original Council were at the dinner and that the attendance was so large. Mr. Petersen had recalled that there were no Papers available for this first meeting. Yet it had been the most successful year in the existence of the Institute, due very largely to Mr. Petersen's own efforts. They were all very grateful for what Mr. Petersen had done for the Institute.

Mr. Nimmo Dewar had already mentioned the part played by members of the Institute in the war effort. His own belief, said Dr. van Eck, was that in addition to the efforts of the men in the field, the Abyssinian campaign had actually been won by members of the engineering industry in South Africa. He considered that members of the Institute should be very satisfied with the results of their contribution. It was due very largely to their efforts that it had been possible to launch the campaign in Abyssinia very much earlier than "the opposition" had anticipated, and this must have made a considerable difference to the result.

A Badge of Office

COL. GUY suggested that it would be a very fine thing if a badge of office could be given to Presidents, and stated his willingness to present such a badge of office. MR. TONGE thanked Col. Guy for his splendid offer of a badge of office to be given to Past-Presidents, and assured him that the offer was accepted in the same spirit in which it had been given. He then asked Mr. Lion-Cachet to say a few words.

MR. LION-CACHET thanked members for the confidence shown in him by making him Vice-President, and sincerely hoped that Mr. Tonge would attend meetings very regularly. In view of the large number of members present he wondered why there was sometimes such a struggle to get a Paper. The past year's meetings had been very successful. Many interesting discussions had taken place, and very often the impromptu discussion meetings had been particularly successful. A very large proportion of our war effort came from the foundry industry. The industry was peculiar in some respects. During the past ten years great improvements had been taking place overseas, which did not seem to filter through to South Africa at the rate which might have been expected, but during the last year foundrymen had become increasingly efficiency-conscious. The application of mechanisation had made great strides, and the trend of discussions was the speedier production of foundry castings. This development was very essential to the Union. In the post-war period South African industries must be prepared to face competition. On the chemical side also great advances had been made, which would be of benefit to the industry and to the whole of South Africa.

MR. ISSELS said it was a great privilege to be present that evening, and the light strain of some of the speeches made it easier for him to say a few words. His visits to Johannesburg were always inspiring, though often in the nature of a busman's holiday. There could be no doubt that a big job of work was being done in foundries and engineering works.

In conclusion, MR. TONGE thanked members for the splendid attendance and the honour which they had done to Mr. Petersen, the members of the Council, and himself. He looked forward to a very pleasant year.

Limits and Fits and Plain Limit Gauges

Two important British Standards have recently been issued by the British Standards Institution, which will be of interest to all engineering works concerned with the questions of establishing manufacturing tolerances on engineering products and of fixing tolerances for gauges which are to control manufacture and inspection. One of these standards comprises a new issue of the B.S. 164: "Limits and Fits for Engineering," originally published in 1924. The second is B.S. 969: "Tolerances for Plain Limit Gauges," which specification is complementary to the recently issued B.S. 919: "Screw Thread Gauge Tolerances." This new Standard includes a comprehensive explanation of the relationship between work tolerances and gauge tolerances and the disposition of the tolerances on both workshop and inspection gauges in relation to the limits of the work. Tables are given for the appropriate gauge tolerances for plug, gap and ring gauges, for all work tolerances from 0.0003 in. to 0.2 in.

These specifications are obtainable from the British Standards Institution, 28, Victoria Street, London, S.W.1, as follows:—B.S. 164, 2s. 3d. post free; B.S. 164, Supplement (Metric Units), 1s. 3d. post free; B.S. 969, 2s. 3d. post free.

(*Concluded from next column.*)

remarks have been made. Foundrymen will appreciate that the course of a dozen lectures, each at least an hour long, would be really inadequate to cover effectively the subject of die castings. The remarks have been made merely to stimulate and start a discussion. The author is only too glad to enter into such a discussion, but asks speakers to bear in mind that by training and practice he is a metallurgist turned into a commercial manufacturer of castings. He is *not* a tool designer, though, quite naturally after many years of close association with the production of gravity chill castings in non-ferrous metals, he does occasionally have ideas about the best method of constructing a particular die.

[The lecturer then displayed several examples of gravity chill castings and aluminium alloy which may be of interest, and a simple example of a die from which successful castings can be produced.]

Die Casting

(*Concluded from page* 221.)

pattern is required, but this is not the calamity financially that it would be in the case of a die.

(5) *The production of the castings is a matter of profound urgency.* With this problem it must be borne in mind that it is very much quicker to produce wooden patterns and coreboxes (or even to prepare and clean up metal pattern plates) than it is to produce satisfactory casting tools.

It is not pretended that the foregoing list of factors is by any means exhaustive. They are merely cited as typical factors, to illustrate the contention that the problem of determining whether or not die castings or sand castings are most suitable should depend upon frank co-operation between the foundry and customer.

Function of a Toolroom

(6) *What is the function of a toolroom in a die foundry*? The toolroom occupies a vastly different relationship *vis-à-vis* the foundry than does the pattern shop to the foundry. For it is in the toolroom that, in the deepest sense, the casting is made. Included in the toolroom there is of necessity the tool designer's office. The author has always maintained, as his own die department manager will confirm, that die casters should be only people who pour molten metal into a hole, and that anyone who is not a congenital idiot should be able to produce excellent castings in the die foundry with almost literally a few days' training—but here must be added a very strong proviso to this rather sweeping remark, for it is in this case essential that the die should be correctly designed, machining of the die blocks and cores accurately carried out according to the design. In such a case the production of castings from that die should be, subject to efficient supervision by the foremen and chargehands.

It is reasonably certain that if anyone suggested that the production in the sand foundry of a satisfactory casting from a really well-made pattern was an automatic affair capable of being undertaken by a mildly intelligent man or woman after a few days' training—he would antagonise, and rightly so, all the skilled moulders in the United Kingdom.

In making this contention of the all importance of the toolroom, it is not for one moment suggested that it is possible to see a customer's blue print, then to sit down for a few hours making sketches, to work these sketches up into production drawings, to use these production drawings in machining up lumps of cast iron and steel, to assemble the machined lumps into a composite die, and to pass it out to the foundry with every certainty that satisfactory castings will automatically pour forth as soon as the die has been warmed up. It is certainly not as simple as that—although such cases do occasionally occur. It is most frequently the case that the die as first produced has to undergo fair modification (even assuming dimensional accuracy) before sound and satisfactory castings can be easily obtained.

Every Die Casting a New Problem

In other words there is no really satisfactory textbook on die design by the use of which automatic success can be obtained if certain rules are followed.

General experience can be gained as time goes on, but every new proposed casting is in effect a new problem. Cast iron and steel are rigid materials, impervious and solid. Hence gating, venting, angles of pour, etc., are very important questions to consider when laying out the outlines for the design of a casting tool.

It is now proposed to end this short talk, realising quite well that only a few very general

(*Continued in previous column.*)

Melting in the Cupola*

CONTINENTAL RESEARCH WORK SUMMARISED

By S. C. MASSARI and R. W. LINDSAY.

Experimental Procedure

Jungbluth and Korschan[3] conducted their investigations on melting conditions in the cupola in a small experimental cupola shown cross-sectionally in Fig. 1. The dimensions indicated are in millimetres, and consequently to convert to feet, they must be divided by 304.8. This cupola was lined to a diameter of approximately 21½ in., and the height from tuyeres to charging platform was about 12½ ft. Central charging was employed. The blower, driven by a direct current motor, could be controlled between the limits of 353 to 1,235 cub. ft. of air per min. All possible sources of air leakage were eliminated by welding of the blast main and the cupola itself. Blast volumes were accurately measured and also were calculated from formulæ. Samples of the stack gas were taken through a water cooled tube located about 1.7 ft. below the charging door, analysed and recorded (with a Monoduplex-K apparatus). Control samples, taken by hand, were checked analytically in an Orsat apparatus.

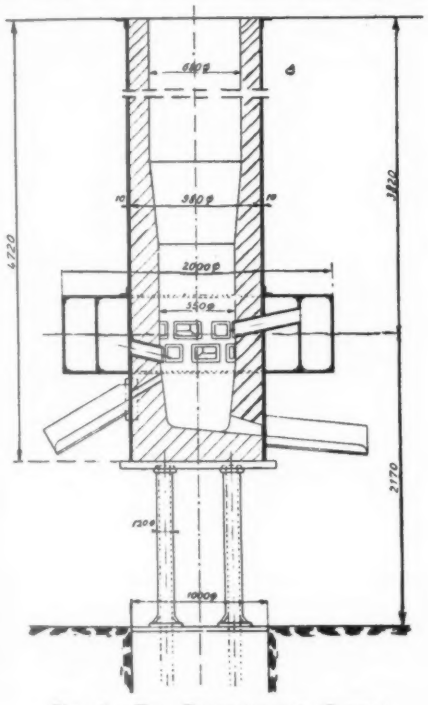

Fig. 1.—The Experimental Cupola Installation.

The charge consisted of pig-iron to avoid carbon absorption and consequent difficulties in the calculations. The pig-iron had the following composition:—TC, 4.16; Si, 2.21, and Mn, 0.69 per cent. A charge, which weighed 660 lbs., was composed of pigs approximately 9 by 4.7 by 4.7 in. The coke used had the following average composition:—Fixed carbon, 88.65; sulphur, 1.07; moisture, 2.20, and ash, 6.39 per cent. The coke was charged as lumps of about 4 to 5 in. diameter and 7 to 8 in. length. The bed coke amounted to 440 lbs.

The limestone had an average composition of 98.7 per cent. $CaCO_3$. It was used in the amount of 6.6 lbs. per 220 lbs. of iron on 6 to 14 per cent. coke charges and 11 lbs. per 220 lbs. of iron on 16 per cent. coke charges. Iron, coke, and limestone were delivered in the same charging bucket, but in separate layers. Each experiment extended over a period of 6 to 8 hrs.

Mechanism of Combustion in the Cupola

A study of the relationship between coke charge and blast volume and their influence on the melting rate and iron temperature permits a close insight into the cupola process of melting. The interdependence of these factors is depicted in Fig. 2. Two facts are immediately apparent from this diagram, namely:—(1) If the blast volume is increased while the coke charge is held constant, the melting rate and the temperature of the iron will increase, and (2) if the coke charge is increased with constant blast volume, the melting rate will decrease and the temperature of the iron will increase.

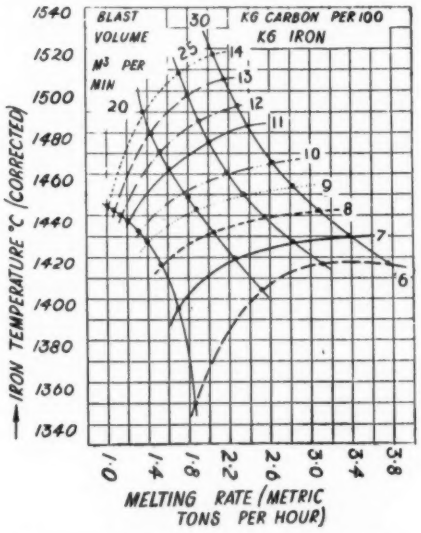

Fig. 2.—Relation between Melting Rate, kg. of Carbon per 100 kg. Iron, Blast and Iron Temperature.

The fact that hotter iron is produced under the second set of conditions is taken to be a rather definite indication that the carbon monoxide found in cupola stack gases is formed by reduction of ascending carbon dioxide in the shaft ($CO_2 + C = 2CO$). It is shown in Fig. 3 that the percentage of carbon monoxide increases as the coke charge increases. The increase in percentage of carbon monoxide is represented in this diagram by a decrease in "n_v," where

$$n_v = \frac{\%\ CO_2}{\%\ CO_2 + \%\ CO} \times 100$$

If the theoretical temperatures of combustion corresponding to various ratios of CO_2/CO are calculated and plotted (Fig. 4) it is seen that low theoretical temperatures of combustion are associated with high percentages of carbon monoxide (or low values of "n_v"). The shaded portion of this line is pertinent to cupola operation. If the carbon monoxide is formed by combustion in front of the tuyeres, it creates the impossible situation in which the iron increases in temperature while the zone wherein it acquires its temperature becomes colder. An investigation by Vogel[4] is offered as an additional support for the assumption that carbon monoxide forms secondarily as a result of reduction of carbon dioxide. This investigation was conducted in a shaft furnace of 4-in. diameter filled entirely with coke. The results obtained using foundry coke are evident in Fig. 5.

It may be noted that in Vogel's experiments the original product of combustion was carbon dioxide mixed with unconsumed oxygen. As this mixture ascended through the hot coke, the oxygen present reacted with carbon to form an increasing amount of carbon dioxide, the oxygen completely disappearing at a height of slightly less than 15 in. above the tuyeres. Meanwhile, carbon monoxide makes its first appearance at a height of almost 12 in. and increases in amount at the expense of carbon dioxide. The percentage of carbon monoxide increased up until a height of about 23½ in. was reached, above which level no further reaction occurred and the ratio of CO_2/CO remained constant.

Further corroboratory evidence for the hypothesis that carbon monoxide results from reduction of carbon dioxide is offered in investigations by Oberhoffer and Piwowarsky,[5] and by A. W. Belden.[6] The former pair of investigators, in connection with an investigation involving the effect of injecting water into the cupola, presented diagrams portraying the gas composition in the various zones of a small cupola of 8.7-in. diameter, which was filled entirely with coke.

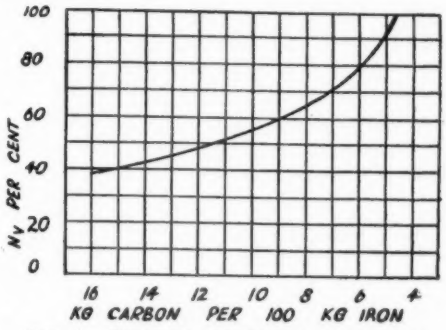

Fig. 3.—Relation between N_V and kg. of Carbon per 100 kg. Iron (After H. Jungbluth and P. A. Heller).

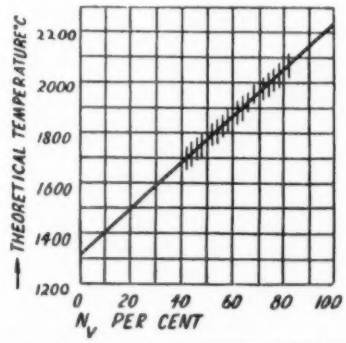

Fig. 4.—Theoretical Combustion Temperature with Varying Ratios of Combustion N_V.

Considering that the most extreme condition occurs, namely, that all of the carbon before the tuyeres originally burns to carbon dioxide, rather simple relations are found to exist between the coke charge and melting rate. Furthermore, a simple conception of the mechanism of melting in the cupola can be developed.

Obviously equal volumes of blast will always burn the same portion of coke to carbon dioxide in front of the tuyeres over a period of

D

* A paper presented to the New York Convention of the American Foundrymen's Association. The authors are respectively Metallurgist and Research Assistant, Association of Manufacturers of Chilled Car Wheels, Chicago, Ill.

Melting in the Cupola

one hour, regardless of the coke charge. This fact can be portrayed by the formula

$$C_w = \frac{60}{8.9} \times W, \text{ where}$$

C_w = the weight of carbon in kilograms burned by the blast per hour, and

W = the volume of blast per minute in cubic metres. The quantity of air required to burn one kilogram of carbon completely to carbon dioxide is 8.9 cubic metres.

The total carbon burned per hour (C_h) can be expressed mathematically as:

$$C_h = \frac{K \times k}{10} \times S, \text{ in which}$$

K = the weight of coke in kilograms used per 100 kilograms of iron,

k = the weight of carbon in 100 kilograms of coke (per cent. carbon in coke × 100), and

S = the melting rate in metric tons per hour (1 metric ton = 1,000 kg. or 2,200 lbs.). The formula is arrived at in the following manner:—

$K \times \frac{k}{100}$ = weight of carbon (in kg.) burned per 100 kg. of iron, and

$K \times \frac{k}{100} \times 10 = \frac{K \times k}{10}$ = the weight of carbon used per 1000 kg. of iron melted (10 times that burned per 100 kg. of iron).

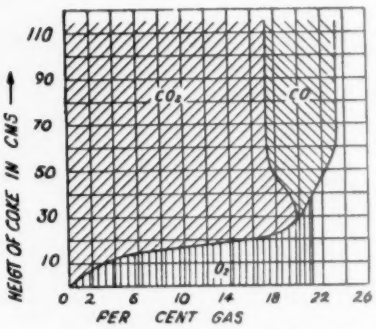

Fig. 5.—Combustion in an Experimental Cupola. (After R. Vogel.)

This value multiplied by S will then give the weight of carbon burned per hour.

The weight of carbon used for reduction of carbon dioxide to carbon monoxide is then equal to

$$C_h - C_w = C_r, \text{ where}$$

C_r = weight of carbon in the coke charge used for reduction of carbon dioxide to carbon monoxide.

The amounts of carbon burned by the blast per hour (C_w) and the total carbon consumed per hour (C_h) are recorded in Fig. 6 for various weights of coke (or carbon) used per 100 kg. or iron, the blast being held constant at 1,412 cub. ft. per min. It will be seen that under these conditions C_w remains constant and is equal to

$$C_w = \frac{60 \times 40}{8.9} = 270 \text{ kg. of carbon per hour.}$$

The total carbon burned per hour (C_h), of course, is related to the coke charge and the melting rate. For a coke charge equivalent to 12 kg. of carbon per 100 kg. of iron (S = 3.05 tons per hr.) C_h would equal

$C_h = 12 \times 10 \times 3.05 = 366$ kg. of carbon per hour.

Under these conditions

$C_r = 366 - 270 = 96$ kg. of carbon are used per hr. in the reduction of CO_2 to CO.

As the coke charge is decreased (Fig. 6), the melting rate increases and C_r decreases until, with a coke charge equivalent to slightly less than 5 kg. of carbon per 100 kg. of iron, all the carbon is burned to carbon dioxide and none is available for reduction. In this case, the carbonaceous constituents in the effluent gases will be entirely carbon dioxide, a purely hypothetical condition when considering practical cupola operation. The connection between the melting rate per hour (S) and the carbon burned per hour (C_h) is given by the equation

$$S = 0.35W - 0.03\ C_h.$$

The Melting Process

A mechanism of the process of melting in the cupola can be postulated on the basis of

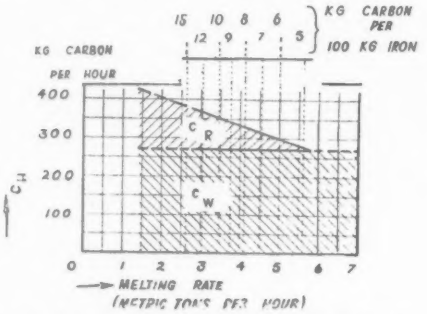

Fig. 6.—Relation between Melting Rate, Carbon Burned to CO_2 and Coke Charge with Constant Blast Volume.

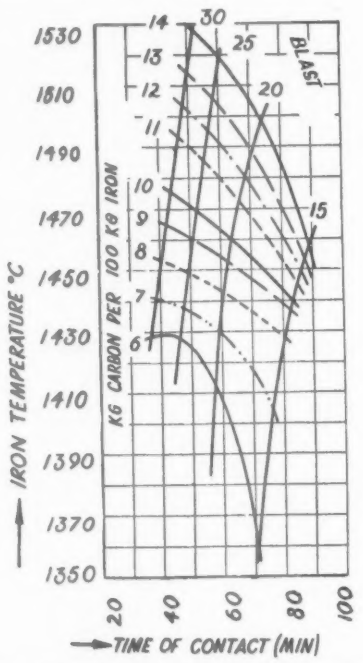

Fig. 7.—Relation between Iron Temperature (Corrected), kg. of Carbon per 100 kg. Iron, Time of Contact between Charge and Gas, and Blast Volume.

these observations. The iron, as it descends in the cupola, passes through a column of incandescent coke, the height of which is completely independent of the quantity of coke charge but instead depends only upon the volume of blast. Therefore, this zone of incandescent coke is of uniform height with constant blast. Increasing the weight of coke charge causes the descending iron to require a longer period of time to reach the melting zone. Consequently the charges are retarded in their speed of descent, less iron passes through the incandescent zone per unit of time, and the melting rate is lowered. Greater melting rate is obtained by increasing the blast with a constant coke charge. The coke is burned more rapidly and the iron charges, as a result, reach the melting zone more quickly.

Heat Transfer

Does the conception of the mechanism of cupola melting, just set forth, conform with the relationships portrayed in Fig. 2? It will be recalled that the temperature of the iron can be increased in two ways, as is indicated beneath the heading "Mechanism of Combustion." The heat requirements of the iron can either be supplied in the solid state by improved absorption from the hot gases in the cupola stack, or in the molten state by absorption from the incandescent coke as it trickles down through the combustion zone. Improved heat absorption from the hot gases by the solid iron, or better preheating, will result from longer periods of contact between the gases and the charges (longer elapsed time in the furnace) and should be accompanied by a lowered temperature of the waste gases. The two methods of raising the temperature of the iron by varying blast volume or coke charge may be considered separately.

Production of Hotter Iron by Increasing the Blast with a Constant Coke Charge

Improved preheating is definitely not a factor under these conditions. The experimental results are contrary in that such conditions result in shorter elapsed times of contact (Fig. 7), and the waste gas temperature actually increases

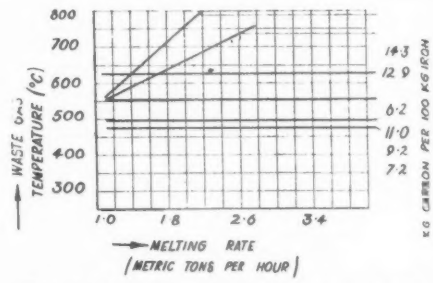

Fig. 8.—Temperature of the Waste Gas with Various Coke Charges (kg. of Carbon per 100 kg. Iron) and Melting Rates.

with the two heaviest coke charges (Fig. 8). The rise in temperature of the iron is apparently due entirely to heat withdrawal by the molten iron from the incandescent layer of burning coke. Under the conditions stated, the depth of the combustion zone is increased and the drops of iron must travel a longer path through an incandescent layer of coke. Consequently the temperature of the iron rises.

Production of Hotter Iron by Increasing the Coke Charge with Constant Blast

Although better preheating (longer time of contact—Fig. 7) may produce higher metal temperatures in this instance, Jungbluth and his co-workers doubt that it does. They are of the opinion that higher iron temperatures are due to the fact that, under these conditions, a smaller quantity of iron passes through the incandescent zone in a unit of time, this zone being of uniform height with constant blast. Since the amount of heat available in this zone is more than ample in any cases, the smaller quantity of iron will attain a higher temperature.

(To be continued.)

Economy in Co and Ni in Enamelling

According to H. Lang in "Keramische Rundschau," Co and Ni oxides used in enamelling can be saved by substituting for them pyrolusite, a mixture of BaO_2 and Sb_2O_5, or fluorides, or by artificial corrosion of the surface of the steel.

Die Casting*

By H. J. MAYBREY, B.A., D.I.C.

Die casting is a term covering a very wide field of foundry technique. In its most general aspect it can be defined by saying that die casting is the action of introducing molten metal into moulds of such a type that they can easily be assembled and taken to pieces, these moulds remaining relatively unaffected by the action of the molten metal poured into them so that they can be used relatively indefinitely for the production of castings. Please note that the word "relatively" has purposely been used twice in this description. It is important to mark this "relativity."

It will be noted that in its widest aspect die casting strictly speaking covers the production of rolling slabs, extrusion billets, wire-drawing billets, etc. However, for the purpose of this talk and discussion it is proposed to cut out certain processes which might be termed in the literal sense, die casting. Included in this cut-out is the production of solid blocks of metal which are made in order that rolling, extruding, forging and wire-drawing operations may subsequently take place. This admittedly excludes without any great logic certain specialised methods of production in metal moulds, such as "flush" casting, the Cothias process, centrifugal casting and others which have a limited, though quite useful, scope. This has been done not because the processes mentioned are not of much use, but because it would not be possible to deal with all the various methods of producing castings in what one might term "permanent moulds" in a short talk.

Two Methods of Die Casting

In practice, when reference is made to a die foundry, one usually means a foundry which is producing castings by two methods or by one of those two methods. These two methods are usually termed in this country:—(1) Pressure die casting; and (2) gravity chill casting. The main difference between these two methods lies in the manner in which the molten metal is put into the mould.

With the pressure die-casting method the metal is forced into the mould mechanically with an applied force. With the gravity chill-casting method, the metal is poured into the mould with only the action of gravity to carry it into the recesses of the mould. In passing, it should be noted that in the United States the expression "die casting" usually means pressure die casting, and what here is termed gravity chill castings are called permanent mould castings.

This is rather unfortunate, since sometimes confusion arises. This confusion is particularly apt to come about when a customer is a branch of an American concern or has strong financial or commercial associations with the United States. The misfortune of this confusion lies in as much as castings made in a pressure die-casting machine can usually be relied upon to be cast to much closer limits than those made in gravity chill moulds, and the customer may be counting upon cutting out a considerable amount of machining which he is unable to do if he receives gravity chill castings.

Now the author would venture to state that die casting (using the term in its widest sense) came into being and developed into the very large industry it is to-day, mainly as a result of economic production-rate considerations. There are, of course, many other advantages die castings can give, but these advantages were usually looked upon as pleasantly incidental ones, though nowadays it is quite frequently these incidental advantages that have taken the first place in deciding whether a casting shall be made in a metal mould or in a sand mould.

The Field for Die Castings

Turning away abruptly from this preamble, and proceeding to consider the subject of die casting itself, a few rhetorical questions suggest themselves:—

(*a*) *What metals* (*or alloys of metals*) *are usually die cast?* They are in groups:—

(1) The low melting point white metals, with tin or zinc base.
(2) Brasses.
(3) Aluminium bronzes (being rather specialised forms of yellow metal).
(4) Aluminium alloys.
(5) Magnesium alloys.

Die castings in all these five groups are quite commonly encountered.

(*b*) *What other metals could be die cast commercially?* Well, quite apart from the production of cast-iron pipes up to quite considerable dimensions by the centrifugal process, a quantity of work has been done in perfecting means of producing iron castings by pressure methods in permanent metallic moulds. There is somewhere in the author's possession at this moment a very interesting pressure die-cast piston pot in special iron, which was made for the production of piston rings. It is not sought to go into the controversial matter of the ideal method of producing piston-ring castings, but it does seem likely that this method of production, *i.e.*, a pressure die casting of "cast iron" is worth a good deal of consideration. The practical study of the problem of rapid production of cast-iron piston rings by mechanical means may open up eventually a vast industry, in a somewhat similar manner to that in which the invention and development of the "Linotype" printing machine, led ultimately to an established prosperous and extensive white-metal die-casting trade.

It would be, of course, true to say that practically all the existing commercial alloys could, by the exercise of ingenuity, be made susceptible to die-casting methods, but the demand might be so small and the ingenuity required to produce useful castings so great as to put the method outside purely economic consideration.

(*c*) *What determines whether a casting shall be made as a sand or die casting, it being assumed that it is reasonably regular practice to produce both sand and die castings from the alloy in question?*

This is a very wide question indeed. In fact, it is a question which is sometimes solved in a very unscientific unplanned and illogical manner. It is unfortunately often left to one of the two parties immediately concerned, *i.e.*, a foundry manager or the purchasing department of the customer. It is, of course, obviously much more sensible if the matter is mutually discussed by both parties with their technical advisers in attendance, for there are other considerations involved than the purely immediate economic ones, and it is the balance of the factors which should influence the position.

Aluminium Alloy Castings

Taking as an example aluminium alloy castings. These are a class of castings with which the author is more particularly concerned these days, and it is proposed to follow the example through in fair detail to endeavour to exhibit certain of the factors which come into play.

It will be assumed that the proposed casting is a fairly simple one, such as, for example, a small hand wheel of 4 or 5 in. diameter, with a raised orthodox rim and four spokes joining together in a central boss of simple cylindrical type. The number of castings contemplated to be ordered is, say, 500.

A wooden pattern for such a casting might cost a few shillings, and even if the pattern were split and duplicated by mounting on a pattern plate the cost is not a great deal. A metal mould or die as people term it, would possibly cost many pounds to make, as the wooden pattern costs shillings.

Admittedly, as far as cost for such castings affects the customer in the first instance, a simple arithmetic sum settles the issue—*if* such total cost for the order placed (*i.e.*, 500 castings) were the sole deciding factor. This is, of course, sometimes the case, and in the instance just quoted, it is very probable that a sand cast article would prove cheaper than the die cast one. For, although, probably the rate of production of a die casting would be somewhat more rapid, hence the castings—as castings—likely to be a little cheaper, the difference for 500 castings would probably not be anything like enough to off-set the considerable difference between the cost of a wooden pattern and the cost of a metallic die.

Analysis of Production

By introducing the relevant factors one by one it can be shown how they could affect the arrival at a sound and logical decision.

(1) *If the order for* 500 *castings is merely a preliminary one.* The customer is really putting out a feeler to market some new departure. He foresees the possibility that he will in fact within a short time be ordering such castings at the rate of 500 a month, and this for some long time. After a few repeat orders of this type he rapidly neutralises the difference in preliminary outlay for pattern and die. Hence, he rapidly gains an advantage by specifying die castings, but this is a matter in which his judgment of future possibility can be the sole guide.

(2) *The casting is one which requires, in order to be employed in his engine or instrument, to be machined all over.* Now, by the very nature of the comparative exactitude of the die casting method, it is possible that the amount of machining required on the die casting may be substantially less than that required on a sand casting. In consequence, there are lowered machine-shop costs with the die casting, and the actual saving of costs may make the purchase of even such a small quantity as 500 die castings the cheaper ultimate proposition.

(3) *The wheel is a highly stressed part requiring heat-treatment.* Now, a metallurgical factor comes into play as, generally speaking, especially with aluminium alloys, the effect of casting into a metal mould with consequent rapid freezing is to produce a much finer grain-structure in the alloy than could be obtained with a sand casting. The die casting, moreover, is less likely to suffer from minor porosity troubles. Hence, the die-casting, particularly after heat-treatment, is likely to be stronger and more ductile and more resistant to shock than the sand casting. This fact may be of such importance as to be practically paramount, and would decide the issue.

(4) *The designer of the article may not be quite certain that his ideas are final.* Experience in use may show that considerable modification in design is required. Now, with a wooden pattern quite large modifications or additions can usually be made at small cost, but frequently such modifications or additions would involve a large outlay with an existing metal die. It does quite frequently occur that a complete scrapping of an original

(*Continued on page* 218.)

* An informal talk given before the London Branch of the Institute of British Foundrymen, Mr. R. B. Templeton presiding.

Some Physical Properties of Sheet Steel Enamels Affecting Hairlining*

By E. E. BRYANT

Introduction

E. C. Greenstreet in his Paper, "Design and Factors Affecting Hairlining,"[1] shows that much in the way of design of shapes and uniform heating of shapes during firing can be accomplished to reduce hairlining of sheet steel parts.

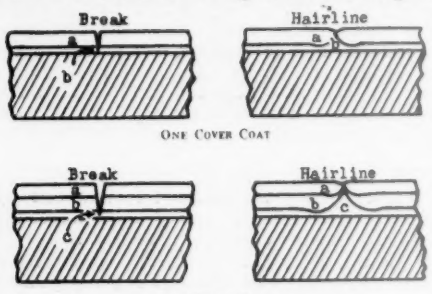

FIG. 1.—GRAPHICAL REPRESENTATION OF THE CROSS SECTION OF A BREAK IN AN ENAMEL COATING AND THE HAIRLINE WHICH MIGHT BE PRODUCED.

It is fairly well agreed that these steps reduce the straining of the piece during heating, thus reducing fracture of the enamel coating and consequent hairlining. Under production conditions it is unlikely that all pieces can be fabricated or handled in a way that will produce no harmful strain in the enamel coating during the firing operation. For this reason it is advisable to consider the physical properties of enamels which affect hairlining. The object of the discussion in this Paper is to show the effect of physical properties of enamels on hairlining. No attempt is made to recommend limits in accepted units for the different physical properties discussed.

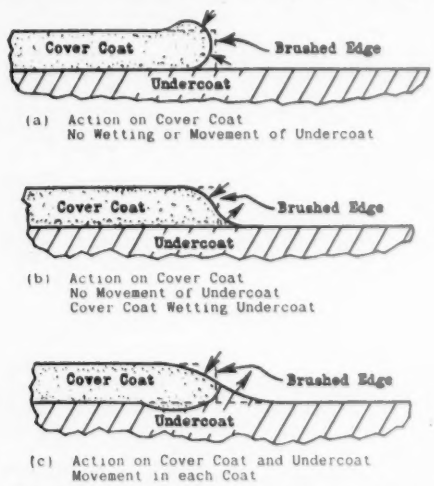

FIG. 2.—SCHEMATIC DIAGRAM OF THE ACTION OF SURFACE TENSION AT THE BRUSHED EDGE OF A COVER COAT DURING FIRING.

THEORETICAL CONSIDERATIONS

The type of hairline considered here is produced by a break in the enamel coating during the early stages of firing. Breaks formed during cooling should be considered craze lines.

Failure Due to Tension

Usually a break in an enamel coating which produces a hairline is caused by tension in the enamel from flexure or uneven expansion of the steel base during firing. A compression break would be similar to fishscale and would not produce the continuous line of break which may result in a hairline.

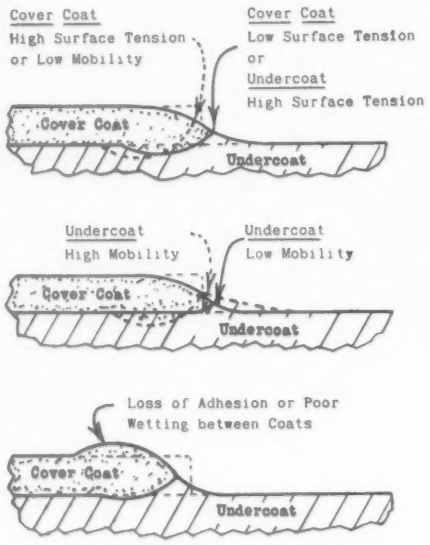

FIG. 3.—SCHEMATIC DIAGRAM OF VARIATIONS IN CROSS SECTIONS OF A BRUSHED EDGE OF COVER COATS.

Coefficient of Expansion.—It would appear that an enamel of higher coefficient of expansion than steel would relieve the tensile stress produced by flexure or uneven expansion of a piece during firing. However, this high coefficient of enamel would probably craze. An enamel of low coefficient of expansion which would be under high compression when cold might relieve the stress. During the first period of heating this compressive stress would prevent any break due to tension. Warpage and chipping prohibit the use of such low coefficient of expansion enamel. In addition to this it is evident that the compressive stresses produced by the low coefficient of expansion of the enamel coat exaggerate the strain produced by heating. Therefore, little or no change in resistance to tensile failure can be made by varying the coefficient of expansion of the enamel coating.

Tensile Strength and Elasticity.—An increase of tensile strength or elasticity might also appear as a means of preventing the tensile failure. Experiments have shown that any attainable tensile strength of an enamel will not overcome the stress produced by shapes which produce hairlines, and no significant variation of elasticity can be produced and retain a commercially practical enamel.

Thickness of the Enamel Coating

It is a known fact that hairlining is directly proportional to the thickness of the enamel coating. This is accounted for by laws of physics which show that with a certain deflection of a piece, the stress at the surface is

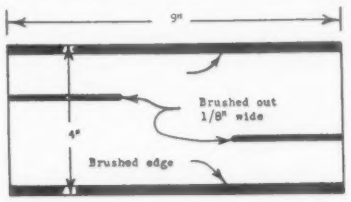

FIG. 4.—BRUSHING OF SAMPLE PLATE.

directly proportional to the thickness of the piece deflected. Since the tensile strength of the enamel is not equal to that of the steel, the deflection of the piece producing tension in the enamel is predominantly controlled by the steel base and areas of enamel under compression. The reduced stress at the surface of thinner coatings results in fewer breaks in the enamel.

Strength of the Bisque Coat

The previous discussion has concerned enamel coatings in general. Now consider the possibilities of reducing hairlines by changing the condition of the bisque cover coat. If the fired coating on a piece is broken by bending or impact and then a commercially acceptable cover coat is applied, the undercoat does not pull up into the cover coat during firing. However, some indication of the break remains as small indentations or if the break is very severe, blisters will occur along the line of fracture. This is true when no further strain is produced during firing of the cover coat. However, if

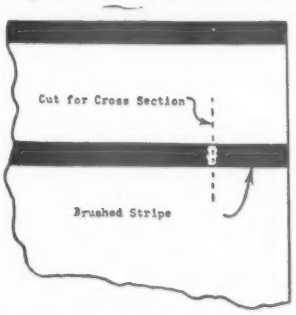

FIG. 5.—SAMPLES FOR CROSS SECTIONS.

the undercoat and the bisque cover coat are broken before firing the cover coat, hairlines are produced where the undercoat breaks and tearing is produced where only the bisque coat breaks. Thus a bisque coat which does not break when the fired undercoat breaks will not hairline perceptibly. However, a bisque coat would need greater strength than the fired undercoat to prohibit breaking when the under-

* A paper presented to the Forty-second Annual Meeting, American Ceramic Society. The author is on the technical staff of the Ferro Enamel Corporation.

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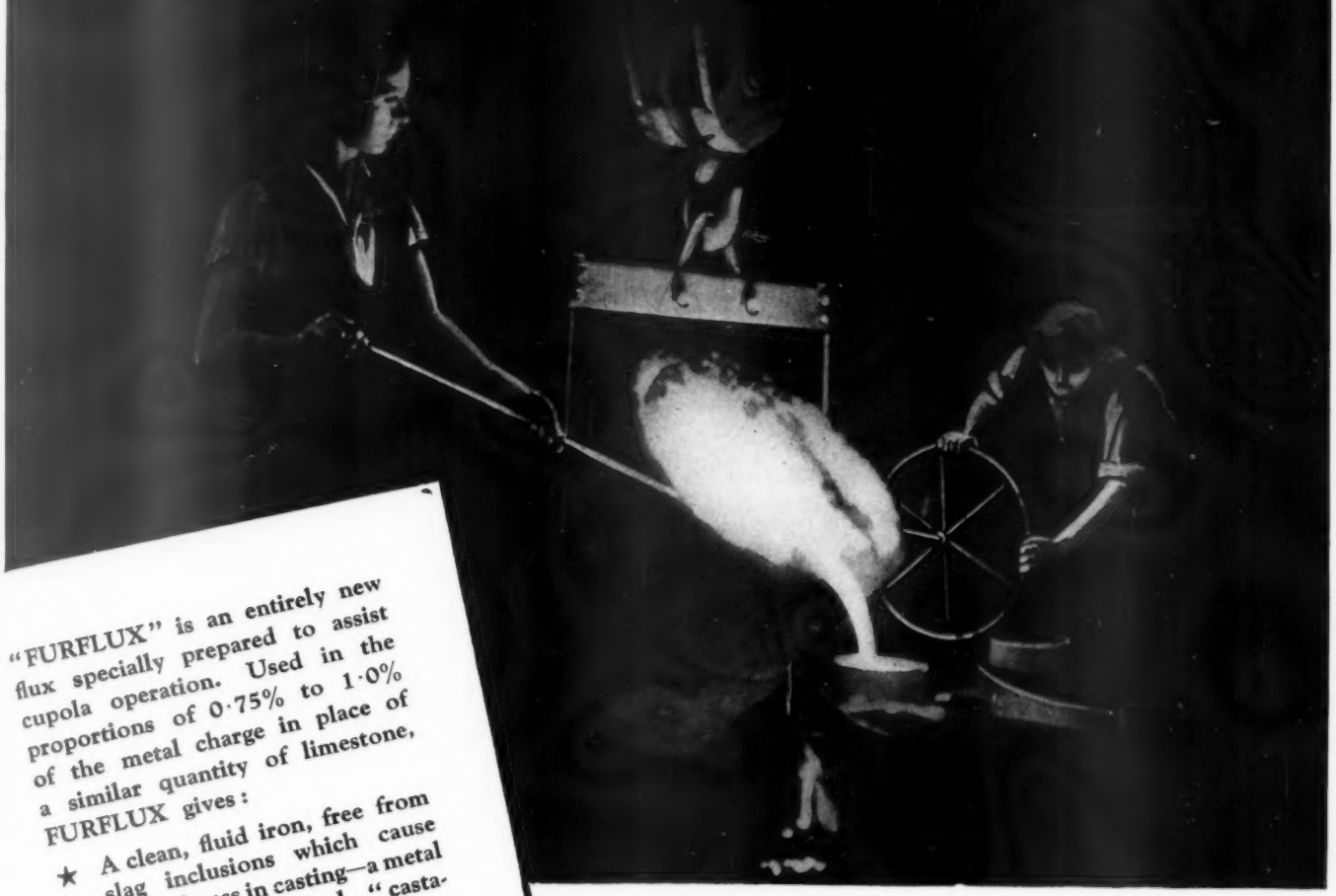

"FURFLUX" is an entirely new flux specially prepared to assist cupola operation. Used in the proportions of 0·75% to 1·0% of the metal charge in place of a similar quantity of limestone, FURFLUX gives:

★ A clean, fluid iron, free from slag inclusions which cause sluggishness in casting—a metal full of "life" and "castability."

★ Trouble-free slagging—the exothermic reactions in the formation of the slag are reflected in hotter metal.

★ A definite limitation of the degree of sulphur pick-up.

★ Refinement of the grain structure gives improved values in physical tests.

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coat is broken. It is self-evident that such a bisque coat is an impossibility. Properties which will tend to reduce breakage of the bisque cover coat are pliability and strength which are maintained until softening of the enamel occurs. These qualities need to be retained till softening, for the breaks that produce hairlines occur at some point in firing, before the enamel is fused.

Formation of Coatings under a Hairline

The foregoing discussion indicates that in commercial practice there will be cases where the enamel coating breaks due to stresses produced during firing. Therefore investigation of the properties of enamels which will allow these breaks to heal during the latter stages of firing were made.

The work presented by B. J. Sweo in his Paper ("Hairlining of Sheet Steel Enamels") serves as a good basis for such an investigation.[3] Sweo reported that a hairline is actually a ridge of the undercoat enamel pulled into the upper coats. The height and shape of the ridge of undercoat enamel is proportional to the severity of the particular hairline. Thus any properties of the different coats of enamel which will tend to keep this ridge smaller will reduce the severity of the hairline.

A graphical representation of the change appearing in enamel coatings from the time a break occurs until firing is complete is shown in Fig. 1. The properties of the enamels producing this change in position of the coatings during firing are: mobility of the undercoat enamels at (*b*) or (*b* and *c*) allowing the undercoat to pull up in the break, surface tension acting on (*a*, *b* and *c*) in the break pulls down on the edges of the break at (*a*) and pulls up on the undercoats (*b* and *c*), and low mobility in (*a*) or loss of adhesion or lack of wetting power allowing (*a*) to separate from (*b*) (the previously fired undercoat) preventing the cover coat from flowing over the break. The time during firing at which the properties of the different coatings exercise their greatest effect, also affects the resulting formation of the coatings. These properties may be a result of fusion between the coatings as well as the properties of the individual coating. The ideal conditions for healing of a break during cover coat fire are an immobile undercoat (*b*) or (*b* and *c*) and a highly mobile and low surface tension cover coat (*a*) which retains adhesion to the undercoat throughout the firing. Practically all undercoats are mobile to some extent. In this case low surface tension of the undercoats (*b*) and (*b* and *c*) will help heal the break.

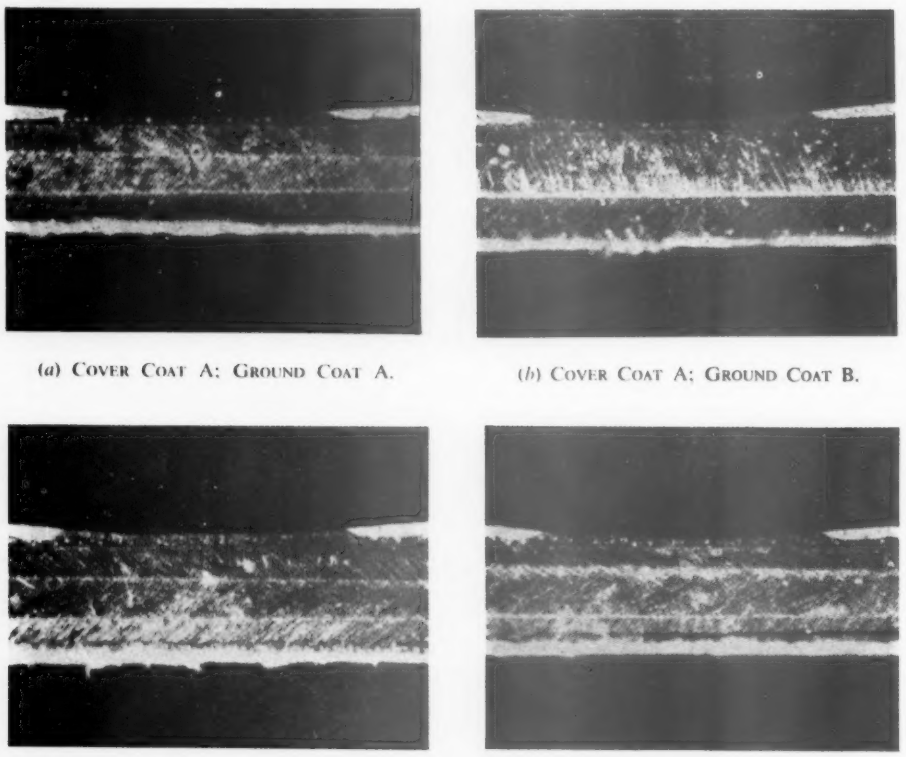
EXPERIMENTAL PROCEDURE

The Use of a Cross Section of the Brushed Edge of Cover Coats for Determining the Properties of Enamels

Since it is evident that a break in the enamel coating must occur to produce a hairline, it is assumed that relatively similar action between the different coats of enamel will occur along a brushed edge of the particular cover coat enamel; *i.e.*, by brushing or scoring, the undercoat is exposed at the edge of the cover coat. This is similar to the result of a break forming in the enamel coating. A cross section of the brushed edge of a cover coat over the ground coat shows a ridge similar to those reported by Sweo.

The use of a brushed edge of cover coat for trial purposes eliminates many variables encountered when breaks are produced by torsion. Cross sections across a brushed edge of cover coats show definite variations which indicate, by direct comparison with other samples, the effect of surface tension and mobility of the coatings and lack of wetting or loss of adhesion between the coating during firing. The schematic diagram of cross sections showing the action of surface tension during cover coat firing (Fig. 2) indicates the forces exerted at the edge of the cover coat under various conditions. Fig. 3 shows the changes in contour of cover coats and undercoats which may be accounted for as indicated in the diagrams. Figs. 1 and 2 are self-explanatory and serve as a basis for the study of cross sections across the brushed edge of cover coats.

Good wetting between coats, high mobility of cover coats, low mobility of undercoats and generally low surface tension of all coatings are desired for healing of breaks to prevent hairlines. Low surface tension is more essential in cover coats than it is in undercoats. An intermediate coat requires undercoat properties in relation to cover coats. However, the intermediate coat must have sufficient qualities of a good cover coat to prevent hairlines if breaks occur during firing of this coat. Correlation of results obtained when enamels are compared for action both as a cover coat and as an undercoat will determine superior intermediate coat enamels.



(*a*) COVER COAT A; GROUND COAT A. (*b*) COVER COAT A; GROUND COAT B.

(*c*) COVER COAT B; GROUND COAT A. (*d*) INTERMEDIATE COAT B; COVER COAT B.

FIG. 6.—MACROPHOTOGRAPHS OF COVER COATS OVER GROUND COATS.

Preparation of Samples

In order to investigate this action at a brushed edge a standard procedure for producing samples was set up. Twenty gauge sample plates measuring 4 in. by 9 in. were cleaned and pickled in the conventional manner. All ground coats were applied by draining to yield 1¼ oz. for both sides of 1 sq. ft. and were fired according to the best commercial practice for the particular ground coat. All cover coats were sprayed at 25 gms. dry weight for one side of 1 sq. ft. and brushed as shown in Fig. 4. The cover coats were fired at 815 deg. C.

Cross Sections and Macrophotographs of Brushed Edges

The samples for cross sections were sheared as indicated in Fig. 5. It was found that chipping which is often a problem in preparing cross sections could be eliminated by grinding back at an angle of 30 deg. to the enamel surface. After the samples were ground back to a good face at 30 deg. to the surface, they were finished to a 90-deg. cross section on emery paper. The final polishing for the macrophotographs was on 4/0 paper. Macrophotographs of the cross sections were made to include both edges of the brushed stripe and the contour of the undercoatings under the brushed area.

Examples of Cross-Section Studies

The procedure outlined in "Experimental Procedure" has been used to determine hairline resistance of many enamels. Trials in production plants have verified the hairlining properties determined by this cross-section method. Studies of two ground coat enamels and two cover coat enamels will show the type of results obtained. Ground coat, cover coat and intermediate coat trial results are as follow:—

Ground Coats

Comparison of the two ground coats is made in macrophotographs, Fig. 6. Cover coat enamels affect the variations of the ground coats. Therefore comparison is made with samples having the same cover coat, *i.e.*, compare macrophotograph "*a*" with "*b*" and/or "*c*" with "*d*." A study of these macrophotographs—taking into consideration Fig. 3—clearly shows that ground coat B as compared to ground coat A has a lower surface tension and is less mobile. Therefore, ground coat B is more resistant to hairlines. Since similar variations between the ground coats are evident regardless of the cover coats used, no property peculiar to a combination of two particular enamels is indicated.

Cover Coats

Comparison of cover coats is made by examining the macrophotographs in Fig. 6. It is essential that comparison be made on samples on

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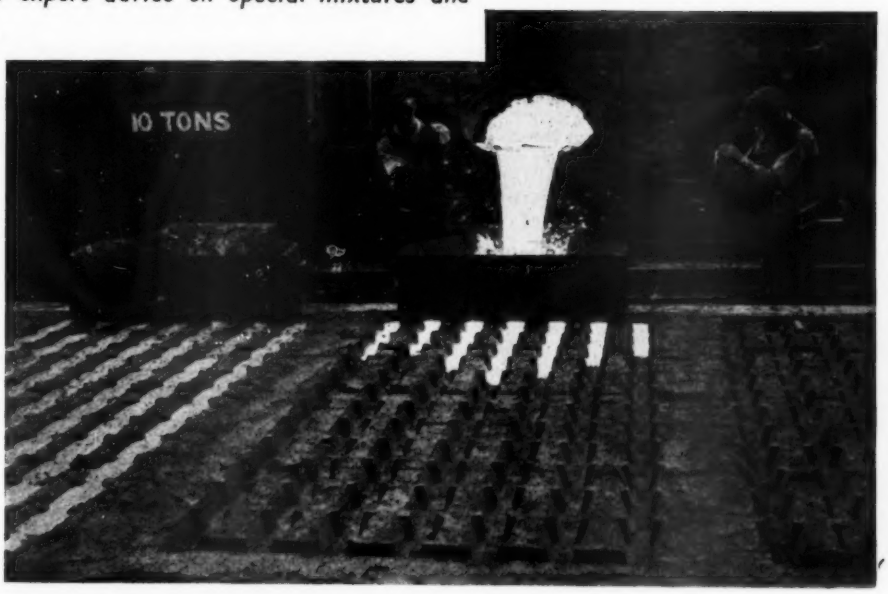
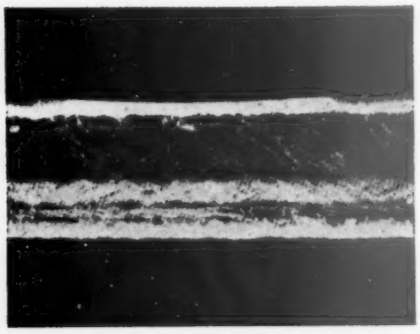


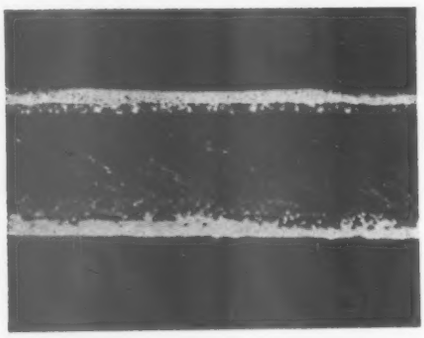
THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

Sheet Steel Enamels

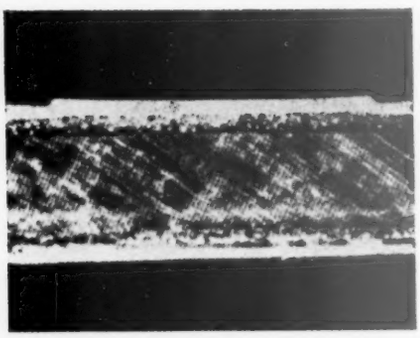
which the same ground coat is used, *i.e.*, compare macrophotographs "*a*" with "*c*" and/or "*b*" with "*d*." A study of these macrophotographs—taking into consideration Fig. 3—clearly shows that cover coat A as compared to cover coat B has lower surface tension and/or more mobility. Therefore, cover coat B is more resistant to hairlining. Relatively similar comparisons may be made by a study of Fig. 7.



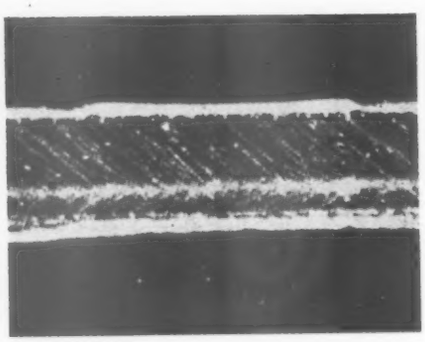
(*a*) INTERMEDIATE COAT A; COVER COAT A.



(*b*) INTERMEDIATE COAT B; COVER COAT A.



(*c*) INTERMEDIATE COAT A; COVER COAT B.



(*d*) COVER COAT B; GROUND COAT B.

FIG. 7.—MACROPHOTOGRAPHS OF COVER COATS OVER INTERMEDIATE COATS.

In this case the cover coats are applied over an intermediate coat. Colour oxides were added to the cover coats to allow distinction between the coatings.

The similar results obtained when these cover coats are applied over ground coats or over intermediate coats definitely shows that the properties determined are characteristic of the cover coats. Lack of wetting or loss of adherence to the undercoat is not shown in any of the samples of cover coat A or B. A macrophotograph of another cover coat which does show this undesirable property is shown in Fig. 8. In this case a very narrow brushed stripe was used so that the full contour of the edge of the cover coat could be included in the macrophotograph. Any cover coat exhibiting this property will produce pronounced hairlining.

Intermediate Coats

Fig. 7 shows macrophotographs of the cover coats A + B used as intermediate coats. The cover coats are the same enamels (A + B) with oxide added to give colour for distinction of coatings. A study of the macrophotographs Fig. 7, and comparing samples under the same cover coat (*i.e.*, compare "*a*" with "*b*" and/or "*c*" with "*d*") shows that intermediate coat B as compared to A is less mobile. Enamel B also has the higher surface tension. However, as pointed out previously, low surface tension is not as essential in an undercoat as it is in a cover coat. Therefore as regards hairlining of the cover coats, intermediate coat B is superior for hairline resistance. The example enamels A + B as cover coats over ground coats (see "Ground Coats") show that in intermediate coat fire enamel B has less hairline resistance than enamel A. However, the thinner coating present during intermediate coat fire reduces the tendency for breaks and if breaks occur they are not as wide. Therefore, on the basis of the samples presented here, enamel B is superior for an intermediate coat.

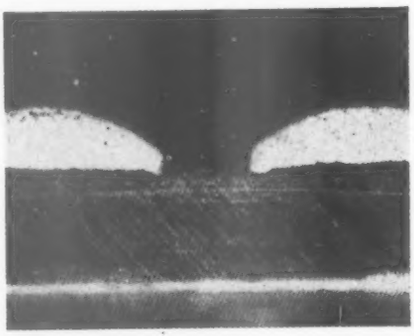


FIG. 8.—MACROPHOTOGRAPH OF POOR WETTING OR ADHERENCE OF COVER COAT TO GROUND COAT.

Conclusions

(1) All hairlines are caused by a break in the enamel coating during the cover coat fire. These breaks are produced by areas of strain which cause tensile failure in the enamel coating.

(2) Good shop practice in the form of proper design of shapes, proper firing and maintenance of thin coatings of enamel will in many cases eliminate breaking of the enamel coating.

(3) Any possible variation of the physical properties of individual enamels has only a slight effect on the resistance to breaking.

(4) After a break occurs, surface tension and mobility of each coating during cover coat fire materially affects hairlining.

(5) Cross sections of the brushed edge of cover coats show definite variations which are accounted for in terms of surface tension, and mobility of the individual coatings and adherence between the coatings during cover coat firing. These determine the relative ability to seal over a break during cover coat firing which is relative hairline resistance.

REFERENCES

(1) E. C. Greenstreet,—"Design and Factors Affecting Hairlining"—Proceedings First Annual Porcelain Enamel Institute Forum, 46 (1937).

(2) B. J. Sweo,—"Hairlining of Sheet Steel Enamels"—Technical Bulletin No. 5, April 1, 1940, Ferro Enamel Corporation Cleveland, Ohio.

Clean Abrasive for Blast Cleaning*

BY C. A. SNYDER,

American Foundry Equipment Company.

Peak metal-cleaning efficiency from abrasive blast cleaning equipment (air or airless) depends on keeping the metallic abrasive clean. Moulding sand, scale and broken-down fines retard cleaning action and increase the rate of wear on the blasting machine. Failure to keep foreign material out of the abrasive can lower cleaning speed as much as 50 per cent.

A ventilating and dust collecting system of adequate capacity and correct design will maintain cleaning efficiency at a high level, if the system is regularly inspected to be sure it is operating as recommended. Here are some of the important points that are often overlooked in this periodic cleaning:—

(1) Don't allow the dust collector to become overloaded with dust—shake the tubes when needed. Hoppers should be emptied daily.

(2) Check the condition of the tubes in the dust collector regularly to be sure they are not torn or damaged.

(3) Check the vent piping at intervals (especially the horizontal pipe section) to make sure that deposits of dust have not accumulated through a drop in air velocity.

(4) Check the belt on the suction fan occasionally to make sure there is no slippage. Be sure the fan is operating at the correct speed and in the right direction.

(5) If the blast cleaning equipment is equipped with an abrasive separator, check it regularly, preferably once a day. The discharge orifice should be adjusted to provide as even a flow of dirty abrasive over the shed plate as possible, and no foreign material should be imprisoned in the slot. Also check the orifice to see that wires or refuse are not retarding the flow of abrasive through the separator.

(6) Be sure that all cover plates and inspection doors are in place, particularly those on the abrasive separator, elevator head, and on the dust collector, otherwise air will be permitted to by-pass through these openings and seriously affect the efficiency of the dust collecting equipment.

* From the Shop Notes section of "Metals and Alloys"

German Foundry Directory

The Directory of German Foundries or Reichsadressbuch des Giesserei-Industrie, giving details of all ferrous and non-ferrous foundries in Germany and in the Protectorate of Bohemia and Moravia, was issued recently by O. Elsner, Berlin (price 15 Rmk.). This volume, of 296 pages, is the second edition; the first edition appeared in 1936.

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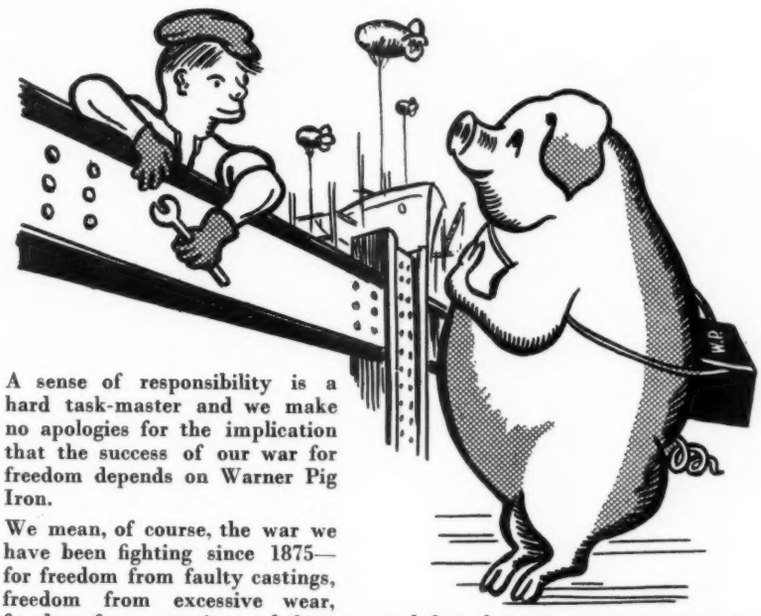

A sense of responsibility is a hard task-master and we make no apologies for the implication that the success of our war for freedom depends on Warner Pig Iron.

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The Week's News in Brief

Trade Talk

THE BOILER EQUIPMENT for a new corvette has been presented to the Admiralty by Babcock & Wilcox, Limited.

MULTIPLE ACTING FLUX, LIMITED, whose registered offices are at Cross House, Westgate Road, Newcastle-upon-Tyne, have opened new offices at 8, Ashgate Road, Broomhill, Sheffield, 10.

TO INCREASE the output of the iron and steel works at Bhadravati, Mysore, which is already responsible for a large part of India's growing production, about £150,000 worth of additional plant is being bought in the United Kingdom.

FERRANTI, LIMITED, electrical engineers, whose borrowing powers are at present limited to the paid-up capital, are seeking authority to increase these powers to double the paid-up capital—that is, to £1,600,000.

THE ANGLO-GREEK MAGNESITE COMPANY, LIMITED, proposes to reduce its capital from £176,250 to £126,250 by returning to preference holders the full £1 per share, thus extinguishing the whole of this issue of 50,000 shares. The capital will then be restored to £176,250.

PRIORITY AID ASSURING the National Steel Company of Brazil of prompt shipment of steel, machinery and other equipment for the completion of its $45,000,000 steel plant within three years has been approved by the relevant United States authorities. This step is in accordance with the United States policy of assisting other American republics to obtain essential materials in the States, so far as is compatible with defence requirements.

THE OPENING MEETING of the Manchester Association of Engineers will be held on Saturday, October 11, 1941, at the Engineers' Club, Albert Square, Manchester, at 2.30 p.m., when Mr. F. Carleton Anderson, M.I.E.E., President of the Association, will deliver his Presidential Address. The Constantine Prize will be presented at this meeting to Mr. O. Rendell for his Paper on "Line Production of Machine Tools," presented during the session 1940-41. The Butterworth Prize will be presented to Mr. S. N. Brayshaw, M.I.Mech.E., for his contribution to the discussions during last session.

THE BUILDING RESEARCH STATION of the Department of Scientific and Industrial Research has issued a further Wartime Building Bulletin, No. 15A, which is a supplement to Bulletin No. 15. This supplement contains modifications of two of the factory types described in Bulletin No. 15 to help their camouflage treatment. A new type design is added for the same reason, and another for steel economy. Working drawings of the steelwork may be obtained by firms engaged on buildings to be erected at the instance of a Government department on application to the Building Research Station, Garston, Watford, Herts, at a cost of 2s., post free, for each type required.

THE FINANCIAL POSITION of the Ironfounding Workers' Association is stated by the secretary, Mr. Hugh Murdoch, in his half-yearly report, to be somewhat serious in view of their obligations to their members who have joined H.M. Forces, and to their superannuated members. The deficit for the six months amounted to £1,057, while for a period of 18 months the deficit totalled £3,003. The position, says Mr. Murdoch, will have to be seriously considered and something done to face their responsibilities and to have a sufficiency of funds in hand to cover the difficult time when peace is restored and until the foundry trade comes back to normal.

A JOINT MEETING of the Sheffield Society of Engineers and Metallurgists, the Sheffield Metallurgical Association and the Iron and Steel Institute, will be held at the Royal Victoria Station Hotel, Sheffield, on Saturday, October 4, 1941, at 2.30 p.m. Dr. W. H. Hatfield, F.R.S., President of the Sheffield Society of Engineers and Metallurgists and Vice-President of the Iron and Steel Institute, will preside. The following Papers will be presented for discussion:—(1) "Examination of a High-Sulphur Free-Cutting Steel Ingot," by E. Gregory and J. H. Whiteley; (2) "The Thermal Relations between Ingot and Mould," by T. F. Russell; (3) "The Formation and Properties of Martensite on the Surface of Rope Wire," by E. M. Trent, and (4) "Note on the Resistance to Furnace Atmospheres of Heat-Resisting Steels," by A. G. Quarrell. An informal luncheon will be held at the Royal Victoria Station Hotel, Sheffield, at 1 p.m., before the meeting.

WOMEN FROM ALL PARTS OF SCOTLAND last week started an intensive course of instruction at the Government training centre at Springburn, Glasgow, to fit them for work in war factories. The trainees are being given tuition in machine operating, precision fitting, oxy-acetylene and electric welding, instrument making, and sheet metal work. It is expected that early next year more than 1,000 girls will be passing through the centre preparatory to taking their places at the benches in the engineering shops and factories. It has been found that a course of 16 or 18 weeks is sufficient to fit the average trainee for duties in the shops and factories producing war materials and the girls show as much aptitude for the work as do the men who are also receiving instruction. The Springburn centre is the second to be opened in Glasgow. Scotland's first Government training centre for women, which was established early this year at Thorlieban, has facilities for dealing with 1,500 women.

Personal

MR. A. B. LLOYD has been elected a director of F. H. Lloyd & Company, Limited, Wednesbury.

MR. G. S. MAGINNESS has been appointed chairman and managing director of the Churchill Machine Tool Company, Limited.

LORD SEMPILL has accepted the invitation of the Council to become president of the Junior Institution of Engineers for the next session, 1941-42.

MR. WILLIAM SAVAGE, chief engineer to Ruston-Bucyrus, Limited, and Mr. C. J. Hyde-Trutch, general works manager, have been appointed directors of the company.

MR. T. C. FINLAYSON has been appointed a director of the Woodall-Duckham Vertical Retort & Oven Construction Company (1920), Limited. He graduated at Manchester University with an honours B.Sc. degree in metallurgy and subsequently obtained the M.Sc. degree by thesis. During the period 1915-1918 he worked for the Factories Branch of the Department of Explosives (Ministry of Munitions). In 1921 he joined the development staff of the Woodall-Duckham Company. He became personal assistant to Dr. E. W. Smith in 1923 and has been deputy technical director since 1932. For the past ten years he has been responsible for the co-ordination of the company's design practice. In 1939 he was awarded (with Mr. W. Grogono) the gold medal of the Institution of Gas Engineers for a Paper on static vertical retorts. He is a member of the Institution of Chemical Engineers and of the Institution of Gas Engineers, and a Fellow of the Institute of Fuel.

Wills

BARRY, STEWART, managing director of William Jacks & Company, Limited £14,532

REID, ALEXANDER, director of A. F. Craig & Company, Limited, Caledonian Engineering Works, Paisley £15,640

LIVINGSTONE, W. G., late assistant secretary of the Iron Trades Employers' Insurance Association, Limited £9,129

GARDNER, HENRY, metal merchant, a director of the Amalgamated Metal Corporation, Limited, and Henry Gardner & Company, Limited... £237,873

Obituary

MR. GEORGE BALFOUR, M.P., died on September 27, at the age of 69. He was born in Portsmouth and was one of the founders of Balfour Beatty & Company, Limited. He was chairman of the company at his death and also a director of 20 electricity supply companies.

WE REGRET to announce the death, at the age of 71, of Mr. Arthur Sellars, chairman of Darby & Sellars, Limited, of Airedale Works, Lawkeholme Lane, Keighley, machine tool manufacturers. This firm was responsible for designing and manufacturing one of the first moulding machines ever to be placed on the market. Mr. Sellars was well known in sporting circles as a county cricketer, and for many years was the chairman of the Yorkshire Selection Committee. He was the father of Major A. B. Sellars, R.A., the present popular captain of Yorkshire.

Organising Industry for War Production

RESPONSIBILITY OF THE MANUFACTURER

A plan for increased war production has been prepared by the Engineering Industries Association and is to be placed before the Government. A memorandum outlining the plan urges that the function of the Supply Ministries should be to buy. Responsibility for the actual function of production should be put on the manufacturers. Manufacturers should be allowed to take the full weight of that responsibility and be given the full authority needed to carry out their task. The whole problem of finance in the war industries should be surveyed at once as regards the provision of funds and the revision of E.P.T., the present system of fixing prices, and the basis for arriving at what are allowable overhead charges.

Organisation of industry for war production is essentially a matter for the producer, says the memorandum. The Government function should be confined to providing adequate inducements and facilities for industry to co-ordinate and manage its own efforts. The business of manufacturing for war production is a task for industry and not for the Civil Service, and consequently all organisations should be built up on industrial and not on Civil Service lines. It is impracticable and undesirable for all essential capital expenditure to be approved by Government officials, because they do not understand what is essential and what is not. All war-time capital expenditure should be related to the production resulting from the outlay.

On the question of small and medium-sized businesses it is pointed out that these form the bulk of the engineering capacity in the country, there are sufficient people capable of managing them efficiently, and it is therefore in the national interest that they be maintained in a flourishing condition. It is hopelessly impracticable to try to provide enough Government officials with enough knowledge of industrial needs to govern these small businesses and to deal, for example, with the huge number of capital and other vital expenditures having to be made all over the country every day.

It is emphasised that what is primarily needed is a new conception of the relationship between Government and industry. Modern business methods should be substituted for Civil Service procedure. Finally, the Association urges that creative post-war planning should be vigorously forwarded, thereby reducing doubts about the future for both employer and employed.

An Organised Coke Industry

BRITISH HARD COKE ASSOCIATION

At a meeting of representatives of coke-oven undertakings, held in London recently, arrangements were completed for the organisation of the coke-oven industry with a view to ensuring the maximum possible effort of that industry in assisting the prosecution of the war.

At the meeting the British Hard Coke Association was formed. This Association represents 98 per cent. of the total production of coke-oven plants in the United Kingdom, and the following members of the executive committee have been appointed to conduct the affairs of the Association:—

Mr. Ralph Alsop (chairman).

Mr. W. J. Dobson, Mr. J. Y. Feggetter, Mr. G. W. Patrick (Durham and Cleveland).

Mr. G. A. Hebden, Mr. W. B. Archer, Mr. N. E. Webster, Mr. G. E. Chicken (Yorkshire and Lincolnshire).

Mr. H. Watson Smith, Mr. F. Scopes (Derby and Notts, Staffordshire and Northampton).

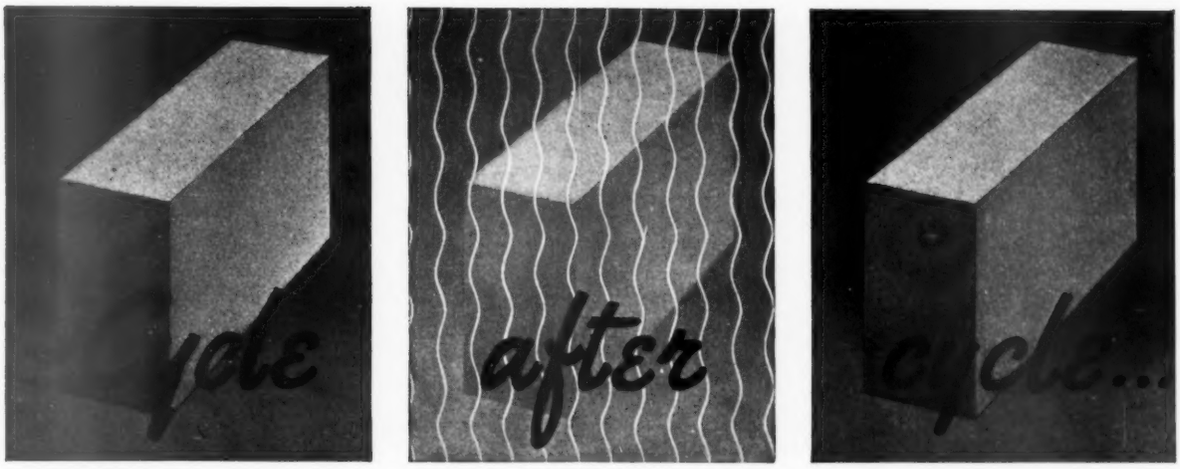
Mr. F. G. Macalpine, Mr. R. D. McCowan (Lancashire and Cumberland).

Capt. T. H. Thorneycroft, Mr. P. Baxter (Scotland).

Mr. Ewart R. Evans, Mr. G. D. Budge, Mr. E. Julian Pode (South Wales and Monmouthshire).

Mr. Leslie O'Connor is the director of the Association and Mr. F. Greenwell secretary.

The Secretary for Mines has expressed the desire that this committee should act in an advisory capacity to the Mines Department.



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Raw Material Markets

Supplies of hematite appear to be rather more plentiful, although distribution is still restricted to consumers engaged on work of national importance and who cannot make do with other qualities of iron. Low-phosphorus iron is also on the short side, but adequate tonnages of high-phosphorus material are available to satisfy all requirements and some buyers have been able to lay down stocks. Reports from all districts indicate that the light foundry trade is still without sufficient work to facilitate full-time operations and that prospects of much additional business coming forward are not very bright, in view of the restrictions on ordinary trade and the small volume of Government business being placed.

Pig-Iron

MIDDLESBROUGH—Demand for high-phosphorus iron in the aggregate represents a fair tonnage, despite the reduced consumption by makers of light castings, and this type of iron is being incorporated fairly freely in the mixtures of heavy engineers, who cannot get all they want in respect of better quality irons. No difficulty is experienced in meeting all demands for high-phosphorus material, however, and the Control authorities are usually willing to permit users to accumulate reserve stocks. Heavy engineering concerns have on hand as much work as they can accept, with the result that full deliveries of low-phosphorus iron are absorbed, together with as much hematite as can be acquired. In addition, a certain amount of high-phosphorus iron is being used by these works, with considerable success. The bulk of the iron produced on the North-East Coast consists of basic iron, which is readily taken up by the steel industry.

LANCASHIRE—Iron consumers in this area have specified freely against current contracts and quite large supplies are being held in reserve at consuming points. Speciality engineers are very active, being heavily involved on urgent contracts for Government departments and other important buyers, so that from this source the demand for foundry iron is at peak levels. Rather dull conditions continue to be reported in the light-castings section, where new business is becoming still more difficult to obtain, while many jobbing foundries are also in need of much fresh business; although some units in this section are quite well situated, none can see far ahead. Allocations of hematite among Lancashire users is much below what is actually required. The shortage of hematite is, however, to a large extent overcome by the utilisation of other grades.

MIDLANDS—A steady flow of orders of urgent importance continues to reach the heavy engineering industry, which is operating to its full extent. Special and heavy castings are being called for in connection with the war machine on a large and increasing scale, so that makers are ensured of brisk employment over a long period. Unfortunately, the supply of low-phosphorus iron and hematite is not sufficient to meet all demands and high-phosphorus iron is being used to eke out supplies of the better class materials. On the whole, this system is proving quite satisfactory, as the quantities of high-phosphorus iron available are in excess of current needs. The amount of purely wartime business which has been circulated in the light-castings industry has so far not been anything like enough to make up for the large volume of lost trade which has resulted from wartime conditions. Works in this section, therefore, are not busy and cannot foresee much change for the better until after the war. Makers of cast-iron hollow-ware are understood to have sent representatives to the Board of Trade to discuss with them the position arising out of the recently announced restrictions on export, and it is hoped that some relaxation of the new Order will follow.

SCOTLAND—Gratifying outputs are being recorded by manufacturers of heavy castings, which are needed in large tonnages by important users. Makers have, in fact, sufficient business on hand to last them for a lengthy time, with the prospect of much additional work coming to hand. Light-castings makers in the Falkirk district, on the other hand, are operating at a reduced level from peacetime standards, as the demand from the building industry and from overseas destinations, which are the mainstays of the trade in normal times, has fallen away alarmingly since the outbreak of hostilities and there has been little or nothing in the way of compensation. Steelworks are calling for ever-increasing supplies of basic iron and local production is being supplemented by iron from other areas.

Coke

While still at a good level, the demand for foundry coke seems to have become slightly quieter of late. Consumption is fully sustained, and the cause of the apparent slackening in new specifications is probably that most of the larger consumers have considerable stocks already on hand. In view of the close proximity of the winter, this is especially satisfactory. For delivery to Birmingham and Black Country stations, the current quotation for Durham best foundry fuel is 62s. 9d. per ton, this price being subject to alteration at any time by the Control authorities.

Steel

Ordinary civil consumption of steel and business on export account have both shrunk to very small proportions, being eclipsed by the insatiable requirements of the war effort. Armaments and munitions entail the use of vast tonnages of steel, and it is on meeting these requirements that the energy of the industry is being focused. Barriers in the way have gradually been removed, until now it may be said that the steel industry is fully harnessed to the needs of a country at war.

Scrap

While, generally speaking, adequate tonnages of scrap metal are reaching consumers, the position regarded in the light of future requirements is not quite so reassuring, as needs will have to be met in the main from home-produced material, which is still not coming forward as freely as should be the case. Many users have considerable stocks on hand, but they are still pressing for additional deliveries as a precaution against possible delays in transport later in the year. Steel scrap is especially well taken up at the present time, but cast-iron qualities are also in good demand and foundrymen are open to accept larger quantities than are now being offered.

Metals

COPPER—Deliveries of copper to the war factories appear to be quite satisfactory, and sufficient metal is forthcoming to meet the needs of the enlarged production drive. Owing to the absence of information as to the statistical position of copper, it is not possible to gauge the amount of the metal held here in reserve, but the situation would seem to be quite sound, although deliveries to non-essential users are virtually suspended. Consumption of the red metal is very heavy in the United States, where better deliveries are being called for by working-up industries. Every effort is being made to improve the supply position, but in the meantime distribution is causing some concern to the authorities.

Advices from Lusaka indicate that the Southern Rhodesian output of copper during August was the highest for some considerable time. Production of munitions in the copper belt is progressing rapidly, and the first consignment has been accepted by the Southern Rhodesia War Supplies Committee. Further expansion in the mines is expected.

TIN—Business in this country continues to be on a moderate scale. Russian interest in the market in the East has subsided, although there is no indication that a resumption of large-scale buying will not be made. While prices have fallen in the East, they have not yet reached American parity, so that U.S. buyers continue to abstain from fresh purchases. It is estimated that the Soviet Union's purchases to date amount to around 3,000 tons. Whereas in Great Britain the tinplate manufacturers are unable to operate at anything approaching capacity because of the lack of steel, the American tinplate trade is working at around 90 per cent. of rated capacity, although some reduction may take place before long if it is found impracticable to maintain the supply of steel to the mills.

Referring to the deliberations of the International Tin Committee on the question of the renewal of the control scheme, Mr. C. V. Stephens, chairman of Kramat Pulai, Limited, addressing shareholders at the annual meeting in London last Friday, said that, in view of the difficulties which at the present time beset the international situation, it would be imprudent to attempt any forecast in connection with the continuation of the scheme. Nevertheless, it was to be hoped that it would be found possible, after nearly 10 years of successful operation, to renew the scheme on conditions such as would afford a reasonable measure of protection and do justice to the industry in general.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £256 to £256 5s.; Friday, £256 to £256 5s.; Monday, £256 to £256 5s.; Tuesday, £256 to £256 5s.; Wednesday, £256 to £256 5s.

Three Months—Thursday, £259 15s. to £260; Friday, £259 15s. to £260; Monday, £259 15s. to £260; Tuesday, £260 5s. to £260 10s.; Wednesday, £260 5s. to £260 15s.

SPELTER—Brassmakers are absorbing very large tonnages of zinc, but there has lately been less activity among galvanisers, consumption of g.o.b. metal declining in consequence. Restrictions on the use of spelter have not been relaxed in any way and no metal can usually be secured for unimportant orders. It is uncertain if the United States is still sending supplies to this country, but it is probable that some American metal is reaching these shores. The American Bureau of Metal Statistics announces that exports of U.S. spelter in June last totalled 9,185 short tons, against 11,301 tons in June, 1940. Exports in the first half of this year were 35,715 tons, compared with 31,450 tons in the corresponding period of last year.

LEAD—Supplies of lead are ample, and a certain amount of the metal is being utilised by consumers of other metals which are less easily procured. According to the American Bureau of Metal Statistics, stocks of refined lead in the United States at the end of August totalled 15,300 tons, compared with 19,200 tons at the end of July. Production during the month totalled 51,200 tons, against 49,000 tons, while despatches amounted to 55,000 tons, compared with 54,100 tons in July.

SCRAP—Supplies of non-ferrous metal scrap are still rather unwieldy, but it is believed that steps will soon be taken to ease the situation, which is causing some embarrassment to merchants.

Reports and Dividends

Vickers—Interim dividend of 4% (same).

Hopkinsons—Interim dividend of 5% (same).

Imperial Chemical Industries—Interim dividend of 3% on the ordinary stock (same).

Horseley Bridge & Thomas Piggott—Dividend on the ordinary shares of 12½% (same).

Ketton Portland Cement Company—Net profit, £58,084 (£61,716); final ordinary dividend of 8½%, making 15% (same).

Wombwell Foundry & Engineering—Net profit, after tax, for the year to July 31 last, £8,011 (£8,460); to depreciation reserve, £2,000; to taxation reserve, £1,500; to general reserve, £500; dividend for the year at 12½% (10%); forward, £5,308.

Stothert & Pitt—Profit for the year ended June 30, after providing for war risks insurance and other special war expenses, £170,623 (£133,958); E.P.T., £93,000 (£42,500); income tax, £51,186 (£33,490); ordinary dividend of 12½% (same); forward, £22,876 (£23,962).

Qualcast—Trading profit for the year to June 30, £112,342 (£99,663); bonus to employees, including management commission, £12,755; A.R.P., £11,293; war damage contributions, £3,103; income tax and E.P.T., £46,434; preference dividend, £2,778; interim ordinary dividend of 10 per cent., £8,920; final dividend of 10%, plus cash bonus of 10%, £15,829; to general reserve, £7,500; forward, £29,475 (£29,695).